

Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System, Phase II

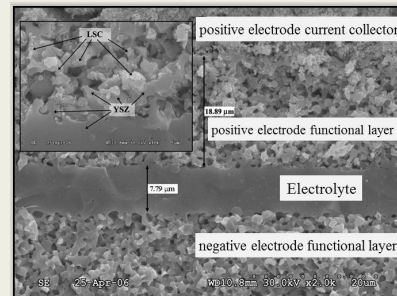
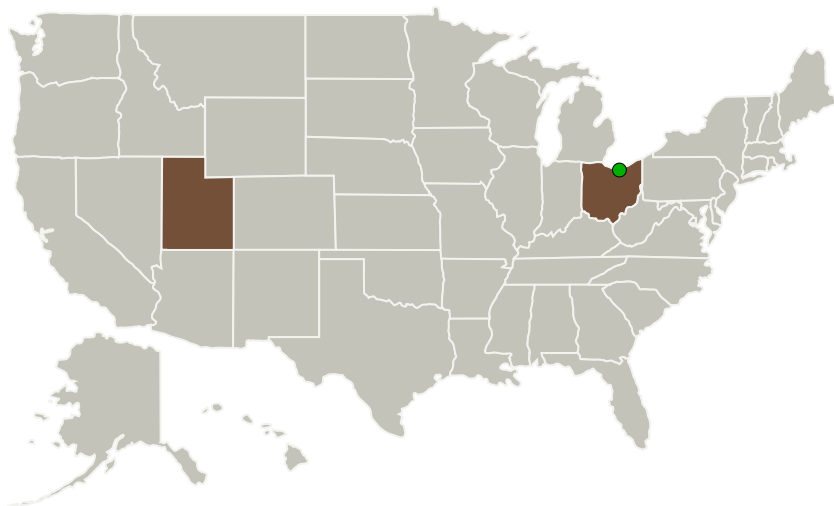
Completed Technology Project (2012 - 2015)



Project Introduction

This small business innovation research is intended to develop a long-life, highly efficient O₂-CO cogeneration system to support NASA's endeavors to pursue extraterrestrial exploration (Moon, Mars, and Asteroids/Phobos). The cogeneration system will be built using a Tubular, Negative Electrode-supported Solid-Oxide Electrolysis Cell (Tune-SOEC) employing MSRI's most promising degradation-resistant ceramic materials and a unique cell design. The system will be capable of co-generating breathable oxygen and CO fuel directly from carbon dioxide extracted from the Martian atmosphere, lunar regolith/soil, or from the cabin air of extraterrestrial human missions at 800°C. In Phase I, CO₂ electrolysis degradation mechanisms were investigated via nonequilibrium thermodynamic analyses and tests of Tune-SOECs with special embedded reference electrodes. Unique solutions for long-term, high performance CO₂ electrolysis will be developed and implemented. In Phase II, a prototype O₂-CO cogeneration system using the Tune-SOEC technology will be developed. A proof-of-concept system will be demonstrated for cogenerating O₂-CO directly from a CO₂ source at pressures ranging from 1 atmosphere to 50 atmosphere at 800°C; showing the capability of using ISRU to generate 1 kg oxygen daily (enough to support 1 human).

Primary U.S. Work Locations and Key Partners



Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System Project Image

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Organizations Performing Work	Role	Type	Location
Materials and Systems Research, Inc.	Lead Organization	Industry Minority-Owned Business	Salt Lake City, Utah
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

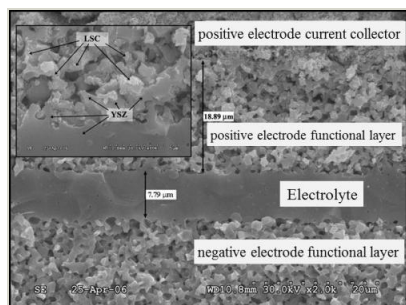
Ohio	Utah
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Project Transitions

**April 2012:** Project Start**May 2015:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/137379>)

Images

**Project Image**

Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System Project Image

(<https://techport.nasa.gov/image/130128>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials and Systems Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

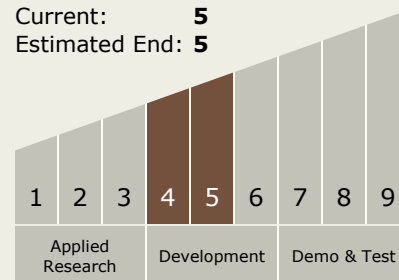
Greg Tao

Technology Maturity (TRL)

Start: **4**

Current: **5**

Estimated End: **5**



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Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.1 In-Situ Resource Utilization
 - └ TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System